TO-15 Testing

How can TO-15 Help You Solve Your Next IAQ Problem?

Have you ever been asked to investigate unpleasant odors in a home or at the workplace? Are occupants developing headaches or a feeling of nausea? It may be prudent for you to include a general volatile organic compound (VOC) scan in your sampling strategy. The best way to sample the widest range of compounds with the greatest of ease is TO-15.

VOCs have been shown to emanate from many building materials including wood, linoleum, paint, plastics, PVC floor covering, glues, wood preservatives, and putty. Mold and other fungi also give off VOCs as they grow and decompose our build materials. These microbial VOCs (MVOCs) have been putatively linked to ill health of building occupants and are indicative of microbial growth somewhere in the building.

For the industrial hygienist, project scientist, or consultant, effectively sampling the air for these VOCs in the field used to be a problem. Traditionally, samples were taken using a sorbent tube and cumbersome sampling pump with the hope that a better method would be developed. With the advances made in instrumentation design and sensitivity, an analytical tool has emerged that provides the best and easiest way to determine the concentration and identity of many organic compounds with a simple and easy sampling technique. This article will guide you through the process of implementing TO-15 testing in your next project.

TO-15's history
Over the past 20 years the EPA authored a series of 'Toxic Organic Compound' methods in ambient air. These methods are more commonly referred to as the 'TO' methods.

The first useful pair of methods was TO-1 and TO-2 where organic compounds were collected on sorbent traps and introduced into a specially-designed cryogenic focusing interface connected to a GC/MS (gas chromatograph/mass spectrometer). This was the method of choice for the EPA for the determination of organic compounds in ambient air at Superfund sites and other toxic sites. To use TO-1/TO-2, the investigator needed to use an air pump to draw large volumes of air across these sorbent traps. The pumps needed to be calibrated and added to the complexity of the sampling event.

Within a few years, TO-14 began to replace TO-1/TO-2 as the method of choice. The main difference to the sampling method employed with TO-1/TO-2 was that a stainless steel vessel, resembling a basketball with a metal frame and valve, was used to collect the sample. The vessel, also known as a 'SUMMA Canister,' was cleaned and evacuated in the laboratory. The SUMMA canister was then sent to the field where the investigator simply opened the valve. The sampling event would begin and end without the use of calibrated pumps or complicated collection media.

More recently, a new flavor of TO-14 has emerged as TO-15. TO-15 uses more sophisticated canister technology. The analytical equipment today is capable of detecting parts per trillion of

certain volatile organic compounds. The GC/MS instrument also makes it possible to look at ‘unknown compounds’ and make tentative identifications. It is this versatility that makes TO-15 one of the most powerful tools that an investigator can use for any initial evaluation.

Advantages of TO-15

TO-15 stands out from other sampling and analysis methods. The sampling protocol is very easy to perform while producing more reliable data than most methods. TO-15 can be used for a wide range of compound types. Some important toxic volatile organic compounds are best handled by the TO-15 whole air approach.

Alternative approaches to whole air analysis in canisters are the thermal desorption and solvent desorption methods. Some compounds aren’t easily desorbed (removed) after adsorbing (sticking) onto the sorbent media, such as the collection methods outlined in TO-1/TO-2 and most NIOSH methods. In the thermal desorption approach, the chemist inserts the collection tube into a specially designed GC/MS interface, and heats the tube to drive the toxic compounds into the GC/MS instrument. Losses can occur if the compounds are thermally unstable and decompose during heating. Other losses can be seen with low molecular weight and extremely volatile compounds, such as propane and the freons, just to name a few. The solvent desorption method, utilized in many NIOSH methods, dilute out the toxic compounds with a solvent thereby preventing low detection levels. Either you thermally decompose your analytes or you dilute them out. Either choice has major drawbacks that can affect your data.

TO-15 collection and analysis affords the best approach to the isolation and identification of your problem toxic volatile organic compounds. Your odor-causing compound may not be detected with other techniques.

TO-15 Sampling Considerations

There are several choices when considering your next TO-15 sampling event. There are several sizes of sampling canisters available for sample collection. Your analytical laboratory can provide 6 liter and 400 ml mini-cans, which are among the most popular sizes. The 6-liter canister affords the best detection limit possible due to the introduction of a 500-ml sample size. The 6-liter canister is recommended for regulatory compliance projects and for those projects where no perceptible odor is detected. The 400-ml mini-can is an excellent choice because of its compact size and ease of use. Use this smaller canister when the identity and concentration of a noticeable odor is needed.

Next, you must choose the sampling regulator. Regulators control the flow of air into the canister and range from 5 minute grab samples to as long as 24 hours. The sampling canister size can limit your sampling interval choices. Ask your laboratory about the available choices.

There are two different types of TO-15 canisters. You can use passivated or non-passivated canisters. The best choice is to ask your laboratory for passivated canisters. These canisters can have trade names such as Silcosteelä , Sulfinertä , etc. The passivated canisters contain an internal coating of glass and/or other inerting agents that are only several molecules in thickness. The coating is bound to the metal and is not subject to breakage or chipping with rough handling. This coating increases the inertness of the canisters allowing better detection of

difficult compounds (e.g. sulfur and polar compounds). Non-passivated canisters do not have this coating on the inside.

The TO-15 canisters and regulators are very expensive and should be handled with the utmost care. Many labs provide a free loaner service provided you return the equipment for analysis within a week or so. Keep in mind that the canister was certified as clean prior to your receipt. If you return the canister to the laboratory without taking a sample, you may still be responsible for paying a new certification analysis the cost of cleaning and certification. Check with your individual laboratory for their current policies. If you want to own your own equipment, the sampling canisters can cost between $500-750 and regulators can average between $700-800 each.

TO-15 Analytical Considerations

The analytical equipment used to perform the TO-15 analysis constitutes a rather large capital investment. The instrument and related sampling equipment can cost between $150 and $250K before any analysis is even started. The sophistication of the laboratory's analytical equipment has a direct correlation as to the usefulness and the quality of the analytical data produced. Your project needs may require state of the art instrumentation and methodologies. Consult with your laboratory and ask how they can service your project needs.

Your laboratory can provide several types of TO-15 analyses. The TO-15 analysis, as written by the EPA, refers to a specific list of 62 regulated compounds (Table 1). These compounds may or may not be important for your project. The list was developed to support the Clean Air Act. Several amendments have been added to the Clean Air Act that include several subsets of additional compounds. Check with your lab to inquire which list they report and their reporting limits of detection. Your particular project may only require a subset of the full list, which may result in analysis cost savings.

If your project does not require TO-15's full list and you want to know, 'what is in my air sample?', you can take a different approach. You can specify the TO-15 full list and ask the laboratory to do a non-target compound library search. This will give you a listing of up to 10-20 extra compounds that are not targets. These compounds are referred to tentatively identified compounds (TICs) and are, as their title states, tentative. This analysis will cost more but can provide you with information that best serves your project goals.

TO-15 Applications and Projects

TO-15 can be used for most IAQ applications. You can use it for odor identification, general investigations, and clearance. TO-15 can also be used in mold investigations by identifying MVOCs. MVOC concentrations were found to be higher in damp buildings with associated complaints than in non-complaint buildings. If mold spores were not detected in an air sample but odors or other signs point towards mold growth in a building then MVOC sampling may be warranted. MVOCs were found to pass through poly sheeting while spores can not. 3-methyl-1-butanol, 2-hexanone and 2-heptone have been used as fungal growth indicators.

We have seen the mini-can sampling system used to find out the degree of hydrocarbon contamination in a building adjacent to a service station. The investigator found a gasoline-type

odor in their workplace one morning and used TO-15 to help determine the source of the odor as well as the concentration. TO-15 was able to show that the contamination was indeed gasoline and possibly from the adjacent service station. TO-15 was also able to show that the air was also contaminated in upstairs office areas where the odor was not as obvious.
The 6-L sampling system was used to find out what was causing an acrid odor on the side of a complainant's home that receives the early morning sun. Some paints contain biocides designed to suppress mold growth. These paints can off-gas mercaptans which have 'dirty sock' odor. TO-15 helped identify the odor compounds.

The mini-can sampling system has been used to perform workplace exposure measurements for various compounds in a pesticide plant. The plant owners were concerned with ambient air concentrations of carbon tetrachloride among other commonly used solvents in that industry.

A facility manager responsible for air quality in a region adjacent to a wastewater treatment plant used a specialized version of TO-15. The laboratory performed SIM (single ion monitoring) analysis using the 6-L sampling system for TO-15. With SIM, the laboratory was able to achieve detection limits 10-100 times lower than with conventional full-scan analysis.

Conclusion

The advances in sampling for volatile organic compounds have made it simple and more effective than in the past. No longer should the investigator worry about calibrating their pumps and finding a power source. Pull out one of the new the canister technologies, open a valve and your sampling is underway. The laboratory takes care of the hard part of analyzing the sample. TO-15 analysis should be considered in your next indoor air quality study.